American Quarterly of Roentgenology

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VOL. IV. FEBRUARY, 1913 No. 3

CASES ILLUSTRATING THE ROENTGEN DIAGNOSTICS OF INTERNAL MEDICINE.

BY A. W. CRANE, M. D., KALAMAZOO, MICH.

The purpose of this paper is to emphasize the mutual dependence of the X-ray, the laboratory and the clinical examination. I shall maintain the following propositions:

(1) The roentgenologist should interpret his own plates and screen observations.

(2) X-ray findings should be interpreted in every case in conjunction with the clinical and laboratory findings.

(3) It is proper and desirable for the medical graduate who devotes himself to X-ray work to take his stand as a consulting diagnostician and to maintain a clinical laboratory in connection with his X-ray equipment.

(4) A clinical laboratory is needed for therapeutic as well as for diagnostic X-ray work.

With these four propositions in mind I will cite a few cases to illustrate Roentgen diagnostics in internal medicine.

Case 1. Miss L., age 24, thin anaemic, complains of cough, expectoration, progressive loss of flesh and strength, loss of appetite, and general malaise. Left shoulder slightly drooped. Expansion on left side lagging, slight dullness in front on left side on percussion below clavicle for a strip of an inch which widens towards median line. Rales heard a part of time over apex and regularly distinguished close to spine at back on forced expiration. A 14 by 17 plate shows heavy wide shadows at the

hilum of each lung with numerous denser foci in scattered groups especially on left side where a thin but definite shadow extends towards the apex. A sample of sputum examined in the laboratory shows numerous tubercle bacilli. The case is painfully clear from the beginning. Every sign and symptom stamps the young woman with the insignia of the army of the white plague. The X-ray has defined with unerring precision the exact extent of the pulmonary invasion. We feel that such cases are only too easy to diagnosticate.

In such cases as these the decisive factor in the diagnosis is not the X-ray plate or indeed wholly the clinical examination. It was the laboratory findings, the examination of the sputum and the Wassermann test.

Case 2. Mr. F., age 60, formerly a train dispatcher. Complains of a persistent pain in right shoulder extending over scapular area and also down arm to elbow. Patient subject to rheumatism. Clinical diagnosis, rheumatic neuritis of branches of the brachioplexus. Treatment by the high frequency and aspirin gave great relief which was, however, temporary, the pain returning each time within a day or two following treatment. This went on for many months. The patient had been stripped and examined in detail several times. On general principles we took a skiagraph of the chest and found a dark shadow above the heart. Screen observations demonstrated an expansile impulse and the diagnosis of aneurism of the aorta was made.

Case 3. Mrs. McC., age 32, complained of pain in right shoulder over scapular region and down arm to elbow. Patient gives a long history of chronic rheumatism. The joints, hand and wrists are enlarged, painful and many are ankylosed. The right knee solidly ankylosed. Almost every joint of the body affected in some degree. Hence the pain in shoulder was diagnosticated as an extension of the old prevalent trouble. The high frequency and aspirin relieved the pain for a few hours. Notwithstanding the clear clinical history pointing to an extension of an infection arthritis, a chest plate was made. A dense shadow could be seen above the heart in the region of the aorta. On fluoroscopic inspection a movement of the shadow could be observed but no unequivocal expansion with each heart beat. Her symptoms were at once ascribed to this growth in the mediastinum. Patient went to a great medical school where the professor of medicine made the diagnosis of aneurism, after

seeing the X-ray plate. The diagnosis nevertheless being between aneurism and mediastinal tumor. A later screen observation gave us evidence of fluid in the pleural cavity. A needle was introduced and a syringe full of clear straw colored serum was withdrawn. The question of tuberculosis now arose. The serum was allowed to clot, the clot whipped to get rid of plasma. The solid residue digested in a thermostat to liquefaction, sedimented in a centrifuge and the sediment examined for tubercle bacilli, bone were found. The Von Pirquit skin reaction was negative. Syphilis is usually the cause of aneurism. A Wassermann was made and was negative. Therefore to assemble the evidence we could exclude tuberculosis and syphilis. We could not define an expansile impulse. We have fluid in the pleural cavity and we have a progressive lesion because the patient grew steadily worse. The diagnosis therefore of mediastinal tumor, probably sarcoma, seemed the inevitable conclusion. Some months later autopsy showed a sarcoma filling in the entire upper part of chest.

Case 4. Mr. F., age 37, harness maker, complained of spells of pain in back in right renal region, frequent and often painful micturition, loss of appetite, sour eructations, pains after eating, general loss of flesh and strength. Urinalysis showed 1% of pus and 1/10% of albumin, acid, sp. gr. 1018. Stone suspected and diagnosis suspended pending X-ray examination. Plates were negative. Case reviewed. Urine obtained by catheter and examined bacteriologically. Tubercle bacilli in large numbers. Diagnosis, renal tuberculosis.

Case 5. Mr. V., age 60, retired, complained of spells of pain in back, frequent and often painful micturition. The symptomatology being substantially as in Case 7 excepting that the general health was not appreciably impaired. Stone suspected. Skiagraphed. No stone found. Bacteriological examination of urine yielded a pure culture of the colon bacillus. Diagnosis, colon infection of urinary tract.

Case 6. Mr. C., age 35, lawyer, illustrates the care necessary to keep from jumping at conclusions. This case was skiagraphed by me many years ago and three stones discovered. It was the first kidney stone case operated upon by Bevan of Chicago, where the diagnosis was made by the X-ray. The stones were successfully removed. A year before another sur-

geon had operated and removed a stone. Three years ago the patient began to complain of spells of pain in the site of the old operations and had cystitis with pus in urine. The clinical diagnosis of urinary calculi in kidney and bladder was strongly supported by the previous history of the case. Repeated plates, however, failed to show stone. We made a bacteriological examination of the urine and showed a pure colon infection.

In confirmation of the diagnosis being the true cause of the patient's suffering in the last two cases, I will add that autogenous vaccines brought permanent relief.

These three cases and they are typical of many, illustrate the importance to the patient of a conjunction of laboratory and X-ray methods.

Cases 7 and 8. Both women past 40 have general dyspeptic symptoms and are typical of many cases. Bismuth outlines upon the plates show that both stomachs are markedly relaxed with the greater curvature of each much below the crest of the ilium. Neither shows any deformity that could mean ulcer or cancer. The look of the duodenum enclosing the head of the pancreas gives no hint of an abnormality in that direction. A second plate 8 hours later shows the stomach empty of bismuth. How many of such cases leave the X-ray expert with purely negative findings and negative findings rarely appeal to the attending physician or to the patient, at their full value from either a diagnostic or pecuniary point of view.

But by having a routine procedure whereby the patient is prepared for the X-ray examination by a night's fast and an Ewald's test breakfast, we are enabled to withdraw the stomach contents partly to insure an empty stomach but chiefly to obtain a sample of the gastric juice for the laboratory analysis.

In case 7, for example, we find a marked HCl hyperacidity.

In case 8, for example, we find HCl subacidity with fermentation acids and excess of indican in urine. Thus we are provided with definition data upon which to base an opinion which is of real value to the patient and the attending physician.

Case 9. Mrs. W., age 30, Anaemic nervous. Complains of constipation and attacks of pain over McBurney's area. Surgical diagnosis:—Recurrent appendicitis. Plates show prolapse of caecum and ascending colon. Pain marker of lead lies over hepatic flexure which has been drawn into the appendix area.

An examination of the stool during an attack reveals typical mucous casts of the colon. Diagnosis, mucous colitis. To have witnessed an operation on this case would have been to have witnessed the removal of one more healthy appendix in the case of so called typical appendix.

Thus the Roentgen diagnostics of Internal Medicine are seen to be inextricably bound with microscope, the stethoscope, and the test tube.

THE PROGNOSIS OF ANKLE AND WRIST FRACTURES, A METHOD OF ESTIMATION FROM X-RAY NEGATIVES.

BY DR. E. H. SKINNER, OF KANSAS CITY.

The prolific use of the X-ray in recent years has forced more attention to the anatomical reduction of fractures. Anatomical reduction is a worthy ambition but our appreciation of functional reduction has been obtunded thereby. We have failed to interpret X-ray negatives with an appreciation of functional prognosis. Our interpretation has forced undue regard to the reduction of fragments rather than the correct estimation of the position of functional joint surfaces. I desire to show you that less attention need be displayed to fragments if the joint surfaces are in correct relation and the lines of weight bearing force are functionally satisfactory. In an attempt to reduce to mathematical exactness, the relation of certain weight bearing surfaces, I present for your consideration the writer's studies upon two of the commonest joint injuries, i. e., Pott's fractures at the ankle and Colle's fracture at the wrist. My work upon the shoulder and hip is not as yet crystallized into simple estimations.

My studies have been pursued with the idea of bringing this method of prognosis within the reach of the physicians outside of the larger cities and where the X-ray apparatus may not be of large capacity. X-ray negatives for these calculations may be made with small portable coils or static machines with or without intensifying screens. The mathematical diagrams herewith presented may be applied to any such negative if the directions regarding the position of the parts are followed.

Fractures at the Ankle.

Axiom.—The functional result of an ankle fracture depends upon the proper reduction of the astragalus so that the line of

weight bearing force, which passes through the center of the tibia, also passes through at its center.

Directions for Exposures of Ankles.

The illustrations which serve to amplify this article are enlargements from small 5x7 plates. The X-ray exposures are always made with the leg resting upon the long surface of a right angle frame and the foot is supported by a Esmarch bandage or heavy rubber bands against the right angled foot piece. The 5x7 plate is placed posterior to the ankle with the lower edge reaching just to the sole of the foot at the heel. The X-ray tube is centered in the adult, one inch above the center of a line connecting the external and internal malleolus. An exposure with even the crudest apparatus will give a negative upon which the line of weight bearing force may be charted whether the fracture line shows or not.

The charting of this described line of weight bearing force may be made upon the finished negative by means of any straight edge. We use a celluloid rule or the taut curtain cord at the window against which the negative is being viewed.

The interpretation of the plate depends not so much upon the shadow of the lines of fracture as upon the shadows of the relative position of the tibia and astragalus. Even in a fair X-ray negative and most certainly in a poor one it is often impossible to determine the fracture itself. I refer here more especially to the fracture sprain of the lower end of the fibula. One must therefore judge of the injury by the position of the astragalus. The difficulty in the X-ray situation is due to the characteristics of the fibula and to the superposition of the tibial shadow upon that of the fibula. The fracture is usually upward and backward from the center of the anterior border of the external malleolus of the fibula with very little and frequently no apparent displacement. It is therefore necessary to possess an interpretative knowledge of the normal ankle joint spacing. The anteroposterior position negative gives us the information regarding the mortise between the astragalus and tibia.

To judge the normal or abnormal relationship of the tibia-astragaloid articulation, we must realize that the head of the astragalus is firmly mortised between the lower end of the fibula and the internal malleolus and is directly beneath the broad articulating and weight-bearing surface of the tibia. This gives only sufficient room between the internal lateral border of the head of the astragalus and the tibia for some ligaments and the action of the joint. The shadow of a normal ankle upon the X-ray plate indicates that there is approximately one-eighth of an inch space in the adult between the astragalus and the internal malleolus. This space increases with the slightest torsion fracture of the fibular malleolus, for it is entirely due to the integrity of the lower end of the fibula that the astragalus remains mortised correctly.

Provided we have established by the X-ray the diagnosis of a torsion fracture of the lower end of the fibula, we are at once interested in methods of reduction and fixation that will promote a functionating ankle as a result. Examination of a large number of results of ankle fractures, both in hospital and private practice has taught me that the proper treatment of these cases is extremely difficult. True the fracture is a slight and simple affair, but the broad, painful ankle that so frequently results, merits our attention to details.

"The secret of the correction of this fracture lies in the proper adaptation of the astragalus to the tibia." The weight bearing line of the tibia is transmitted to the foot by way of the broad articulating surfaces of the tibia and astragalus. It is essential that this relationship be maintained to insure a useful ankle joint. For years we have enjoyed an epigram something like this: "Take care of the tibia and the fibula will take care of itself; the fibula has no function and the tibia bears the weight of the body." In contrast I would advocate. "Reduce the astragalus and avoid painful ankles." And to properly reduce the astragalus requires attention to the fibula, for by the lower end of the fibula alone is the astragalus properly adapted to the weight-bearing tibia.

The astragalus supports the weight of the body upon its broad surface, articulating with the broad inferior surface of tibia. The external malleolus only serves to keep the astragalus in place. It bears no weight. It only forms the external border of the ankle mortise.

A line drawn through the center of the tibia extends through the center of the astragalus. This line may be charted upon the anteroposterior X-ray negative by applying a line to the center of the tibial shaft and extending it downward through the shadow of the astragalus. This vertical line should always extend through the center of the astragalus if the ankle joint is in normal position.

Now we know that the integrity of the ankle depends upon how well the lower end of the fibula performs its mortising function. The large majority of ankle fractures and chronic ankle sprains are fractures of the external malleolus in the manner described in a previous paragraph. It frequently happens that the position of the fragment in a fracture of the external malleolus is in apparently good position but the mortise of the ankle joint is sprung open by the slight outward displacement of the fibular fragment. Conversely, we may have a poor alignment of the fracture but a splendid reduction of the astragalus. It is therefore unnecessary to pursue futile manipulations of the fibular fragment if the astragulus is in correct alignment.

While it is not within my province to proffer surgical advice, it has been my experience that the best results have followed the application of the Duyugtren splint. This method has received ample description in Scudder (1) and Stimson (2). A Duyugtren splint necessitates the internal rotation of the toes, which promotes the correct reduction of the astragalus.

One will readily see that the slightest displacement of the astragalus externally, presents a widened ankle space and if this is not corrected, the patient will ever after have an abnormal line of weight-bearing force. In some cases the ankle may adapt itself to the new position but a little attention to the position of

the toes will avoid many painful and weak ankles of tardy convalescence. A good motto for the surgical attendant should be: "Watch the toes or turn the toes in."

It does not matter what the form of fracture at the ankle whether only of the fibula or of the classical Pott's type or a crushing injury, for, if the anteroposterior X-ray negative shows the astragalus centered under the tibia the prognosis of a functional result will be more favorable than any anatomical alignment of fragments. Nature is wonderfully tolerant of fragments if she can maintain her functional joint surfaces.

Fractures at the Wrist.

Axiom—The styloid process, not just the tip of the radius, is constantly distal to the line which touches the tip of the ulnar styloid, which line is at a right angle to the longitudinal axis of the radius: The functional result of fractures of the radial head depends upon the reduction of the head of the radius to this position:

Method for X-ray Exposure of the Wrist.

The difficulty in obtaining and interpreting lateral views of the wrist has lead us to this charting of the wrist joint upon a single posteroanterior X-ray exposure. The affected wrist and the naturally extended hand are placed with the palmar surface upon a 5x7 X-ray plate with the one short end of the plate at the web of the thumb. The tube is centered over a point midway between the styloid processes of the radius and ulna. This latter is the simplest X-ray exposure of the whole body and can be easily obtained by any X-ray installation which may be totally inadequate for other parts of the body. The resulting plate provides shadows of the proximal portions of the metacarpals, the carpus and about three inches of the radial and ulnar shafts.

Anatomical Considerations. In the normal extended hand the long axis through the center of the radial shaft passes between the proximal epiphyses of the second and third metacarpal bones. In backward displacements of the fractured radial head the radial rotation of the carpal area and metacarpals usually

bring this line between third and fourth metacarpals. But this single line is not sufficient to judge the radial position from the single posteroanterior X-ray negative. So we must add the line at right angles to this longitudinal axis of the radius at a point corresponding to the tip of the ulnar styloid. If the styloid of the fractured radial head is behind this line it is not properly reduced and if left in this position there will remain a functionally imperfect wrist.

It does not matter what the nature of the fracture at the radial head, whether it be an epiphysial separation in youth or a comminuted fracture of the aged, if the reduced radial head provides the above normal charting two lines, one may rest assured of the functional result.

The functional result depends upon the proper adaptation of the carpal articulating surface of the radius. The articulating surface of the normal radius with the carpus is tilted so that the plantar edge of the radial head is always distal to the palmar edge. The correct position of the radial styloid according to the above charting necessitates the normal anatomical position of this articulating surface.

Many writers have described the dropping of the ulna, or the separation of the ulna as the cause of bad results in Colle's fracture. But these objective findings depend upon the tilting backward of the radial articulating surface at the wrist. Furthermore it does not matter if the apposition of the fragments is faulty in contour if the extension is sufficient to replace the articulating surface in its normal position for weight-bearing function.

It is the tilting back of the radial head that interferes with the function at the wrist and this can only be overcome by the full extension of the fragment and the consequent normal position to the articulating surface of the radius.

This charting has been applied to X-ray negatives of all varieties of fractures at the radial head with satisfactory results.

One must be careful to have the head naturally extended for the exposure. Do not try to straighten out the hand where the wrist is fractured but let it assume a natural comfortable position. Any unnatural change in the position of the hand alters the relation of the metacarpals to the longitudinal axis of the radius, the first line of our calculations. But such a change in the metacarpal position does not in the least alter the platting of the position of the radial styloid with relation to the second line which is perpendicular to the first and just touches the tip of the ulnar styloid.

The charting of the wrist is not as impressive as the ankle calculations unless one familiarizes himself with the normal position of the radial styloid. One must insist upon the whole of the radial styloid being distal to the second right angled line of above described calculations before a favorable prognosis is possible. It is impossible to measure the definite length of styloid process which should be distal to the transverse line. In the adult male it should be at least 3/8 of an inch.

No. 1

No. 1. Normal ankle joint taken in the antero-posterior position and showing that a line drawn through the center of the tibial shaft will pass through the center of the astragalus. Note the normal apposition of the astragalus under the tibia. It is more necessary to reduce the astragalus than to obtain anatomical reduction of the fibular fragments when the ankle is fractured.

No. 2. An old fracture of the ankle, with extreme displacement of the astragalus. Note the relation of the astragalus to the line through the tibia. The weight of the body in walking is carried to the foot by the shaft of the tibia and if the astragalus is not centered under the tibia there is more or less pain and discomfort in walking.

No. 2

No. 3

No. 3. An old fracture of the ankle. It will be noted that the ankle mortise is broader than normal and the astragalus is not centered under the tibia as the space between the astragalus and the internal malleolus indicates. The line down the center of the tibia shows that there is more of the astragalus external to the line than in the normal ankle.

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No. 4

No. 4. Pott's Fracture of the ankle. Taken after attempted reduction. More than three-fourths of the astragalus is external to the plotted line, indicating that further reduction is necessary.

No. 5. Fracture of the lower end of the fibula after reduction. It will be noted that the anatomical reduction of the fibula appears to be very good but the position of the astragalus is not satisfactory and if the ankle were left in this position there would be an abnormal line of weight-bearing force. This illustrates the necessity of interpretating X-ray negatives with regard to the functional prognosis rather than to the anatomical position of the fragments of a fracture.

No. 5

No. 6

No. 6. Fracture of the lower end of the fibula without a perfect anatomical reduction of the fragments but with a very good reduction of the astragalus. This case made a good recovery. This also illustrates the value of functional prognosis over anatomical reduction of fragments.

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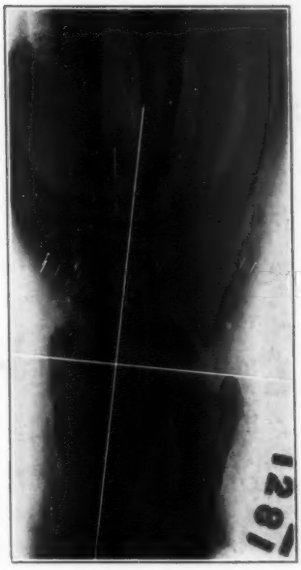
No. 7. Illustrating the plotting of lines upon the postero-anterior negative of the wrist. In the naturally extended hand the long axis of the radius usually passes through the interval between the second and third metacarpal bones, but this may be trifle altered if the hand is cramped or influenced by bandages. Note that the styloid of the radius is entirely distal to the horizontal line, which is at right angles to the long axis of the radius and just touches the tip of the ulnar styloid.



No. 7

No. 8

No. 8. Fractured radius. Note that the styloid of the radius is proximal to the cross line, indicating a backward and upward displacement of the radial head. The long axis of the radius now passes down between the third and fourth metacarpal bones owing to the rotation of the hand and carpal area with the displaced radial head.

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No. 9

No. 9. Lateral view of same case as No. 8. This is shown to prove the interpretation made under No. 8, and to show the direction of the joint surface of the radial head when there is a backward and upward displacement of the radial head. Normally, the joint surface of the radial head exhibits the dorsal edge distal to the palmar edge but when there is any displacement backward and upward it exhibits just the opposite, which is here illustrated. See No. 11 for normal position.

No. 10. Fractured radial head reduced. This is the same case as No. 8 after reduction and while in a plaster cast. Note that we now have the normal plotting of the two lines and the styloid of the radius is distal to the cross line.

No. 10

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No. 11. Lateral View of No. 10, showing the head of the radius reduced and the joint surface of the radius in normal position. Compare this with No. 9. This is the normal position of the joint surface of the radial head with the dorsal edge distal to the palmar edge.

No. 11

No. 12

No. 12. Separation of the radial head at the epiphysis with backward and upward displacement of the radial head. Note that the radial styloid is proximal to the cross line which may be interpreted as indicating the displacement of the radial head.

No. 13. Lateral view of No. 12, which proves the interpretation of No. 12. Note the abnormal position of the joint surface of the radial head.

No. 13

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No. 14

No. 14. Fracture of the radial head with displacement of the radial head backward and upward as indicated by the position of the radial styloid in relation to the cross line.

No. 15. Lateral view of No. 14, proving the interpretation and indicating the abnormal position of the joint surface of the radial head.

No. 15

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WHAT IS THE ROENTGEN PICTURE OF BONE TUBERCULOSIS?

BY ROLAND HAMMOND, M. D., PROVIDENCE, R. I.

This question would seem to be readily answered by reference to the numerous articles on Roentgenology and bone disease in books and current literature. On referring to these articles however, we find a striking lack of unanimity as to the Roentgen appearance of bone tuberculosis. It is generally agreed that the bones composing a tuberculous joint show marked increase in radiability, due to bony atrophy; that the outline of the cortex is often wanting in places, and that the bones at the point of most marked involvement give a "fuzzy", "fluffy" or "shaggy" appearance due to punched out areas of increased radiability. The author of a well-known textbook mentions the bone atrophy, and the numerous, irregular white spots having a natural tendency to coalesce, and then shows as typical of bone tuberculosis, a focus in a finger which might equally well have been a bone cyst or a localized osteomyelitis (Brodie's abscess). The lesion was undoubtedly tuberculous in this case, but the Roentgen appearance is not diagnostic of that disease alone.

It will be generally agreed, I think, that the typical picture of bone tuberculosis is due to the bony atrophy caused by the disappearance of lime salts. This leads to the familiar comment of the patient, or possibly the physician as well, when the plate is exhibited: "Too bad the picture didn't come out better." Part of the haziness of the picture is due to the presence of fluid in the joint and surrounding tissues. And yet this bony atrophy is the foundation on which we base our diagnosis and our prognosis. Freiberg[1] quotes Köhler as describing three types of bone atrophy in Roentgen pictures: 1. Diffuse atrophy of high degree. 2. Diffuse atrophy of varying degree with irregular mottling in certain places. 3. No atrophy unless in a circumscribed area where the shadow is less dense.

In the earliest stage of a tuberculous joint, the Roentgen plate may be to all appearances normal, but another plate taken one or two months later will show beginning bony atrophy, extending for quite a distance on either side of the joint. This atrophy

first appears as a diminution in the size of the bone, and later as an increase in radiability of the texture of the bone. In addition to this, will usually be found loss of contour of the bones forming the articulation, with the fuzzy, shaggy appearance denoting necrosis, and the denser shadow of the soft parts, due to the presence of fluid and of infiltration. Later we may get a localized area of necrosis, often filled with pus and debris, which casts a shadow of varying distinctness according to the density of the contained matter, and after this, the formation of sequestra. As the process goes on to healing, we have a return to the smooth, regular bony outline, and as the healing ostitis becomes marked the shadow is denser than in normal bone.

Differential Diagnosis. In syphilis the bone is not translucent but rather porous, and we have the dense shadows of the periosteum and cortex with at times partial obliteration of the medullary cavity. It is said that these thickenings are never found in tuberculosis, and this is true in the early stages when diagnosis is most essential and most difficult. They may be found in the later stages, especially when the shaft is involved.

In rhachitis the pathological process is most active near the epiphyseal line, but the bone outlines are clear except for a "flaming out" and cup-shaped defect of the diaphysis.

Scurvy shows a hammered out epiphysis giving the horizontal, irregular shadow characteristic of this disease. The subperiosteal hemorrhages are also typical when present.

Osteomyelitis is more likely to give confusion in the Roentgen plate when we are dealing with that rare condition—tuberculosis of the shaft. Oftentimes it may be impossible to distinguish between the two by the Roentgen plate alone. There are the punched out areas of increased radiability and the bone atrophy, but we do not find the periosteal involvement in tuberculosis, except in disease of the shaft.

Osteosarcoma rarely involves the neighborhood of the epiphyses and the atrophy is localized. It pushes up or involves the periosteum and is usually sharply differentiated from the rest of the bone structure.

Bone cysts are always sharply differentiated spaces within the bone which is healthy everywhere else.

Does the Roentgen plate give us an accurate means of diagnosing bone and joint tuberculosis? It does, if used in connection

with a clinical study of the case. The Roentgen plate shows us bony atrophy and differences of density according to well known physical laws. Bony atrophy may be due to many causes, especially following trauma, fixation,—the so-called "plaster of Paris disease,"—and disuse. It is now recognized as a frequent accompaniment of atrophy of soft parts following disease or injury, and as such may give a picture on the Roentgen plate closely simulating tuberculosis in the early stages.

Very often the plate does not give us an accurate idea of the extent of the disease. On opening such a joint, it is the experience of surgeons to find areas of necrosis and extensive involvement which are unsuspected from the examination of the plate alone.

The work of Feiss[2] along this line is noteworthy. He made Roentgen examinations of specimens of tuberculous bone which had been obtained at operation or autopsy. The bone was first X-rayed as a whole and the picture obtained corresponded to the condition found in the living. The specimen was then sawn in two and one half of it was X-rayed. The Roentgen plate of this half showed the disease to be more extensive than the plate of the entire bone. The Roentgen picture was deceptive because the bony trabeculæ along one edge of the cavity were thickened and thereby gave the appearance of a limiting wall which did not exist. In another case a vertebra appeared perfectly healthy when X-rayed as a part of the spine, but when sawn in two and one half of it X-rayed, marked tubercular involvement was found. This was not suspected in the original Roentgen plate, because the trabeculæ were superimposed and gave a normal shadow.

Tuberculous Diaphysitis. Stiles[3] of Edinburgh, in a recent article, devotes considerable attention to the subject of tuberculous diaphysitis. Although of uncommon occurrence in this country, tuberculosis of the shaft is found by Stiles very commonly in Scotland, and Murphy[4] of Chicago coincides in this view. That this condition does not prevail in Germany is shown by Küttner[5] who, in an examination of 2127 cases of tuberculosis of the bones and joints, found but six cases involving the shafts of the long bones. The Roentgen plates exhibited by Mr.

Stiles are not typical of tuberculosis as we are familiar with the disease, but this is doubtless to be attributed to the differences in the characteristics of the affection in the two countries.

With an idea of getting some information of possible value on the Roentgen appearance of bone and joint tuberculosis, I have examined plates of all cases of this disease at the Rhode Island Hospital, in which a pathological examination of tissue removed later, has shown definitely that the process was tubercular. The plates cover a period of nine years, and include the principal joints in the body.

We may conveniently group these cases according to their Roentgen characteristics:

Group 1. Typical Roentgen Appearance of Bone Tuberculosis.

Case 1. Female, ae. 21. Diagnosis: Tuberculosis of right elbow. Duration 3 months. Operation: curetting of ulna.

Roentgen examination: Necrosis of olecranon with fuzziness and loss of contour.

Case 2. Male, ae. 38. Diagnosis: Tuberculosis of ankle. Duration 5 months. Operation: curetting of astragalus, and later amputation of foot.

Roentgen examination: Typical fuzzy appearance of astragalus and lower part of tibia.

Case 3. Male, ae. 2. Diagnosis: Tuberculosis of elbow. Duration 7 months. Operation: curetting of ulna.

Roentgen examination: General haziness of elbow joint with destruction of tip of olecranon and coronoid process.

Case 4. Female, ae. 39. Diagnosis: Tuberculosis of foot with pulmonary tuberculosis. Duration 1 year. Involvement of all the tarsal and metatarsal bones. Operation: Curetting and later amputation of foot.

Roentgen examination: Marked atrophy of all bones of foot and leg. Some destruction of astragalus in forward part and partial fusion with scaphoid; also atrophy and destruction of cortex of external cuneiform and fifth metatarsal.

Case 5. Male, ae. 23. Diagnosis: Tuberculosis of first metatarsal and knee. Duration 3 months. Operation: osteotomy and curetting of first metatarsal.

Roentgen examination: Disease of lower two-thirds of first metatarsal, most marked in lower third where areas of necrosis are seen. Cortex is wanting, especially at metatarso-phalangeal joint. All bones are thinned, especially the internal cuneiform.

Case 6. Male, ae. 5. Diagnosis: Tuberculosis of ankle. Duration 3 months. Necrosis of lower epiphysis of tibia. Operation: curetting of bones.

Roentgen examination: Haziness and general atrophy with destruction of lower portion of lower epiphyses of tibia and fibula and upper portion of astragalus.

Group II. Showing merely Atrophy. Not typical of Tuberculosis, but disease present.

Case 7. Male, ae. 17. Diagnosis: Tuberculosis of knee. Duration 3 months and longer. Involvement of tibia and femur. Operation: resection of knee.

Roentgen examination: Beyond slight atrophy of bones and thickening of soft parts and evidence of fluid in the joint, the Roentgen picture is not remarkable. The bones appear normal, and yet at operation considerable areas of necrosis were found in the femur and tibia.

Group III. Tuberculosis of Several Joints.

Case 8. Male, ae. 6. Diagnosis: Tuberculous osteomyelitis. Duration 6 months. Involvement of lower end of tibia, hand, sterno-clavicular joint and left ilium. Operation: osteotomy and curetting.

Roentgen examination: Ankle—Increased radiability of lower part of shaft of tibia, with thickening of the periosteum. Fairly sharply defined spot of necrosis in lower part of shaft of fibula, a smaller spot in epiphysis of fibula, and one in lower epiphysis of tibia. Above diseased area bone is normal. *Hand*—Small, well defined area of increased radiability in terminal half of the

terminal phalanx of the thumb, and one in the outer side of the second phalanx of the middle finger.

Case 9. Male, ae. 2. Diagnosis: Tuberculosis of elbow and foot. Duration 6 months. Involvement of ulna, humerus and fifth metatarsal. Operation: excision of metatarsal bone and resection of elbow.

Roentgen examination: Considerable destruction of terminal part of fifth metatarsal with loss of cortex; one area of increased radiability in center of bone. Anterior fourth of bone totally necrotic. Other bones show loss of sharp outline and considerable atrophy.

Case 10. Female, ae. 52. Diagnosis: Tuberculosis of Metacarpal Bones. History of rheumatism in hand for 18 to 20 years with a relapse 6 months previously. Under observation for 6 months, when a swelling appeared on dorsum of left hand over the metacarpal bones. Operation: Bone removed from fifth metacarpal for diagnosis found to be tubercular.

Roentgen examination: Necrosis of heads of third, fourth and fifth metacarpal bones of right hand, with fracture of shaft of fifth just below head. Fusion of bases of fourth and fifth metacarpals and somewhat of the third. Disease of os magnum, unciform and pisiform with fusion of os magnum and unciform.

Group IV. Tuberculosis of the Diaphysis.

Case 11. Female, ae. 11. Diagnosis: Tuberculous Osteomyelitis of Tibia. Duration 2 years. Operation: osteotomy and curetting. Pus sterile.

Roentgen examination: Considerable thickening of periosteum and cortex of lower third of tibia with encroachment on medullary cavity by wavy thickenings of cortex. Areas of increased radiability just above the epiphysis.

Case 12. Female, ae. 7, Diagnosis: Tuberculosis Osteomyelitis of entire shaft of Tibia. Duration 7 weeks. Operation: osteotomy and curetting. Sinus found at time of operation from which pus was oozing.

Case 5. Male, ae. 23. Diagnosis: Tuberculosis of first metatarsal and knee. Duration 3 months. Operation: osteotomy and curetting of first metatarsal.

Roentgen examination: Disease of lower two-thirds of first metatarsal, most marked in lower third where areas of necrosis are seen. Cortex is wanting, especially at metatarso-phalangeal joint. All bones are thinned, especially the internal cuneiform.

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Roentgen examination: Haziness and general atrophy with destruction of lower portion of lower epiphyses of tibia and fibula and upper portion of astragalus.

Group II. Showing merely Atrophy. Not typical of Tuberculosis, but disease present.

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Roentgen examination: Beyond slight atrophy of bones and thickening of soft parts and evidence of fluid in the joint, the Roentgen picture is not remarkable. The bones appear normal, and yet at operation considerable areas of necrosis were found in the femur and tibia.

Group III. Tuberculosis of Several Joints.

Case 8. Male, ae. 6. Diagnosis: Tuberculous osteomyelitis. Duration 6 months. Involvement of lower end of tibia, hand, sterno-clavicular joint and left ilium. Operation: osteotomy and curetting.

Roentgen examination: Ankle—Increased radiability of lower part of shaft of tibia, with thickening of the periosteum. Fairly sharply defined spot of necrosis in lower part of shaft of fibula, a smaller spot in epiphysis of fibula, and one in lower epiphysis of tibia. Above diseased area bone is normal. *Hand*—Small, well defined area of increased radiability in terminal half of the

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Case 12. Female, ae. 7, Diagnosis: Tuberculosis Osteomyelitis of entire shaft of Tibia. Duration 7 weeks. Operation: osteotomy and curetting. Sinus found at time of operation from which pus was oozing.

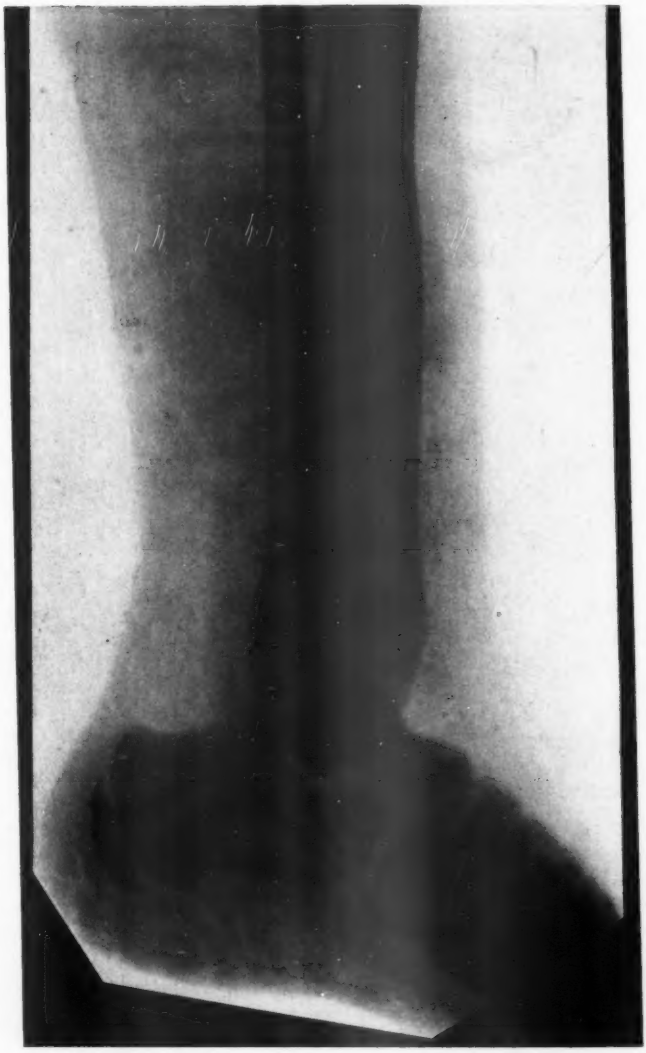

Fig. 1.

Case 11. Tuberculous Osteomyelitis of Shaft of Tibia. Note thickened periosteum and cortex with wavy outline of latter. Almost no involvement of epiphyses.

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Fig. 2.

Case 12. Tuberculous Osteomyelitis of Shaft of Tibia. Marked atrophy of both bones. Periosteum thickened and infiltrated throughout. Numerous small areas of necrosis. Epiphyses normal.

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Roentgen examination: Marked atrophy of both bones. Periosteum thickened and irregularly infiltrated in places, but mostly well-marked throughout. Periosteum generally thickened, mostly on the internal and posterior borders. Bone "spotty" throughout. Epiphyses normal.

It may be argued in the above cases that the condition present in the diaphyseal type is not due entirely to the tubercle bacillus, but is the result of secondary infection. As against this, it may be said that the cultures from the pus showed no organisms, which is consistent with tuberculosis, and also careful pathological examination of the tissue showed only a tuberculous process.

Conclusions:

1. Bone tuberculosis, when typical, is not difficult to diagnose in the Roentgen plate, especially when the clinical examination goes hand in hand with it.

2. Bone tuberculosis in its atypical forms may resemble Roentgenologically infectious osteomyelitis, syphilis, bone cyst as well as other forms of bone disease.

3. The Roentgen plate gives no idea of the extent of the disease, except in a general way, and a serious bone lesion may be present with a negative Roentgen finding, except for bone atrophy.

4. Tuberculosis of the shaft is occasionally found, and when present closely resembles infectious osteomyelitis and syphilis.

REFERENCES.

[1]Freiberg, A. H.: International Clinics, Vol., IV., Fifteenth Series.
[2]Feiss, H. O.: Jour. of Medical Research, 1904, XI., 431.
[3]Stiles, H. J.: Jour. Amer. Med. Assn., 1912, LVIII., 527-534.
[4]Murphy, J. B.: Jour. Amer. Med. Assn., 1912, LVIII., 1096.
[5]Küttner: Beit. z. klin. Chir., Bd. XXIV., Heft 2.

THE ROENTGEN RAYS IN THE DIAGNOSIS OF GASTRIC AND DUODENAL ULCER.*

BY GEORGE E. PFAHLER, M. D., PHILADELPHIA, PA.

In the development of the diagnosis of Gastric and Duodenal Ulcer by means of the Roentgen Rays, we owe most to Haudek, whose extensive experience, careful observation and conservative conclusions, have established this as a valuable method of diagnosis. Most valuable, similar and confirmatory observations have also been made by Faulhaber, Rieder, Tornay, Holzknecht, Jonas, Groedel, Stierlin, Reiche, DeQuervaine and others.

The Roentgenological evidence of gastric ulcer may be grouped under three headings as follows:

1. The *evidence of perforation.*
   a. A projecting shadow outside of the gastric shadow.
   b. A gas bubble lying above this collection of bismuth.
   c. Perigastric adhesions or involvement of other organs.
   d. A palpable tumor connected with the stomach, but not affecting the lumen.
   e. The above may be associated with either an organic or spasmodic hour-glass contraction of the stomach.
   f. Retention of bismuth in the ulcer after the remainder of the stomach has been emptied.
   g. Resistance corresponding to the projecting shadow.
2. The evidences of irritation due either to a *florid* ulcer, or to an irritable scar of an ulcer.
   a. Spasmodic contraction.
   b. Retention of food in the stomach beyond six hours.
   c. Painful pressure point corresponding to the location of the ulcer.
   d. Normal outline of the stomach.
3. Secondary effects usually associated with a callous ulcer.
   a. Pyloric stenosis and gastrectasis.
   b. Fixation.
   c. Organic contraction—hour glass.

*Read by invitation before the Philadelphia Clinical Association, Nov. 4th, 1912, in a symposium on Gastric and Duodenal Ulcer, with the demonstration of lantern slides from 20 cases that were confirmed by operation, and 20 other cases with typical evidence but not operated upon.

d. Interference with peristalsis.
e. Reversed peristalsis.
f. A contracted lesser curvature with retraction of the pylorus toward the left.

The Penetrating Gastric Ulcer is the only one that can be demonstrated directly, and the evidence will depend upon, and vary with, the degree, or extent of penetration.

1. The projecting bismuth shadow outside the normal stomach shadow, may be no larger than the tip of the little finger, or may be several inches in length and an inch or more in width. It has been most often found on the lesser curvature in the body of the stomach. It may occupy the posterior wall, or anterior wall, in which instance it can only be observed by careful oblique illumination; and its location can be determined by the degree of projection during rotation. This projecting shadow cannot be easily moved, though that will depend upon its location and depth.

2. A collection of gas lying above the projecting shadow of bismuth has been noted by Haudek and others. This will depend upon the extent and direction of the penetrating ulcer. If upward and extensive, it is likely to be found. If downward posteriorly or slight, it is not likely to be found. In one case of mine it was found above the liver and under the diaphragm.

3. Perigastric adhesions form in nature's attempt to wall off the ulcer. This will distort the stomach; will interfere with the peristaltic waves over part of the stomach, and is likely to change the position of the stomach. They are likely to render the stomach partially, or completely, immobile. They are most likely to involve the pancreas, the splenic flexure of the colon, or the under surface of the liver and hepatic flexure of the colon.

4. A palpable tumor may at times result, due to the perforation and formation of fibrous tissue resulting from the secondary inflammation. If this is connected with the stomach, but does not encroach upon the lumen, it is evidence pointing more to an old perforating gastric ulcer, than to carcinoma.

5. Hour-glass contraction of the stomach is commonly associated with a perforating gastric ulcer. It most often affects the greater curvature, and may be spasmodic or may be due to adhesions; or may be partially organic and partially spasmodic. This hour-glass contraction may affect any part of the stomach, but is most often found in the lesser curvature. If this constriction is associated with fixation it is most likely to be organic.

6. Retention of bismuth in the bed of the ulcer after the stomach is empty, may occur even when no projecting shadow is present. This is true when the ulcer is on the anterior or posterior wall. A plate of this character has been demonstrated to me by Bassler of New York. This cannot be expected often and must be interpreted very carefully. I believe that ulcer cannot be directly shown excepting perforation to a considerable degree has taken place. In one case studied by myself, such a deposit was recognized, but no evidence of ulcer was found at operation. The operation was undertaken on account of adhesions of the bowels, but the stomach was explored. In no case should such retention be interpreted as ulcer unless it is accompanied by other confirmatory symptoms and Roentgenological evidence.

7. Resistance corresponding to the location of the projecting shadow will furnish confirmatory evidence.

Florid Ulcer, or an irritable scar following an ulcer, gives rise to certain sensory and reflex or spasmodic symptoms that can be demonstrated roentgenologically.

1. Spasmodic hour-glass contractions commonly occur in connection with acute or irritable ulcers, even though there be no perforation, projecting shadow, nor retention of bismuth in the bed of the ulcer. These spasmodic hour-glass contractions have been most thoroughly reviewed by Stierlin, and according to him were recognized even by the old anatomists—Home 1818, Tiedemann and Gmelin 1836; Büdinger in 1901 at operation saw a spasm of the circular fibres of the stomach at the location of an old scar. Jonas in 1906 saw a spasmodic hour-glass contraction of the stomach which was not present at a second examination. In 1908 I observed a case in which an hour-glass contraction persisted and with no change and no peristaltic waves during at least an hour and a half while under observation. In this instance the contraction occupied the middle of the body of the stomach, involved both the lesser and greater curvatures, and was unusually wide. In fact, the whole stomach was contracted, and as I interpret it, was in a tetanic contraction. This was associated with numerous indentations such as are seen in carcinoma, and a diagnosis of carcinoma was made. At operation, by Dr. Laplace, only a small ulcer was found on the lesser curvature, and otherwise the stomach was normal. Observations upon these hour-glass contractions have been made by Jolasse, Haudek, Faulhaber, Schmitt, Rieder, Holzknecht, Stierlin, and others.

In general the contraction occurs opposite to the location of the ulcer, and usually only affects the greater curvature. The indentation may only be a half inch in width and may completely bisect the stomach; or may be only a half inch in depth. Often the walls of the stomach at the point of indentation, are quite smooth, and give the appearance of a string drawing the greater curve upward. At other times the indentation is wide and the walls irregular. It may be present only occasionally, or may be found of the same character at repeated examinations. It is much more likely to vary in character and extent than an organic constriction. It is excited by the presence of food.

I have seen a similar hour-glass constriction in a case of tabes, in which instance the contraction occurred during the gastric *crises*. I also saw a complete hour-glass constriction at the junction of the middle and lower third of the stomach in a physician who suffered from attacks of renal colic (movable kidney), and who had *no* stomach symptoms at any time, and who had *no* symptoms nor abnormal sensations at the time of these contractions. They occurred only at intervals, lasted about twenty minutes and then disappeared completely. Stierlin also reports a spasmodic hour-glass contraction observed in a case of tabes. He also publishes a picture of a case observed by Staehelin in which a similar hour-glass contraction occurred in a case of cirrhosis of the liver, (controlled by operation). As a rule, however, these spasmodic hour-glass stomachs occur with gastric ulcer. Those not due to gastric ulcer are apt to be less constant in their picture and of course, are not associated with the other evidence of gastric ulcer. Multiple deep spasmodic constrictions, affecting both curvatures, may occur in neurotic subjects, as observed by Stierlin, as well as myself.

2. *Retention of food in the stomach beyond six hours* if not accompanied by tumor formation or in an otherwise normal stomach, is one of our most valuable signs of acute or florid ulcer. Ashbury, at the meeting of the American Roentgen Ray Society, in 1910, in his report had recognized this retention of large quantities of bismuth in the stomach in gastric ulcer, and demonstrated them in lantern slides, but unfortunately he interpreted it as being retained in the bed of the ulcers. It was after one of these demonstrations before the American Gastro-Enterological Society that I called attention to the fact that this must be the result of spasm of the pylorus.

The real credit of the recognition and elaboration of this valuable evidence belongs to Haudek and Holzknecht. It is an accepted fact that the passage of the acid chyme into the duodenum causes the normal closure of the pylorus, and that it reopens when the acidity has been neutralized in the duodenum. With hyperacidity it is, therefore, reasonable that each period of closure of the pylorus will be longer, and as a result the passage of the food from the stomach will be delayed. Vice versa, if achylia or hypoacidity be present, the period of each closure of the pylorus will be decreased, and as a result, other things being equal, the stomach will empty itself more quickly than normal.

It is a generally accepted fact that no normal stomach, under normal conditions, will retain food beyond six hours, and the bismuth meal, which is usually given (Rieder Meal—Bismuth subcarbonate 40 grains; Milkbroth, 300 C. C., or Pfahler Meal—Bismuth subcarbonate, 1½ ounces, and fermalac or kefir, fermented milks, 12 oz.) under normal conditions leaves the stomach within four hours.

This spasmodic retention of the bismuth meal beyond six hours, has been found when the ulcer is located high as well as low. Holzknecht believes this may be due to a dragging of the ulcer on the pylorus, or due to hyperacidity. This evidence is best elicited by giving the patient the bismuth meal on an empty stomach, and examining the outline of the stomach, its position, peristaltic movements, lumen, mobility, localized tenderness, etc., and then examining the patient again at the end of six hours for any retention. If the patient has not been seen after the first meal, he should now be given a second; or if the observations at the first examination have not been entirely satisfactory, it can now be repeated. Retention of food beyond six hours rarely occurs in marked gastroptosis without ulcer.

3. Painful Pressure Point may at times be located. If this is found to lie over the stomach, and to move with the stomach shadow, it points toward gastric ulcer. This was pointed out by Crane, as well as Haudek and others. By this I mean that one may find a painful point corresponding, for example, to the lesser curvature. This changes its position from the recumbent to the standing posture, and even with deep respiration.

4. A *Normal Stomach Outline,* and even normal persistaltic waves, may be present in acute gastric ulcers, and yet the retention of food associated with such normal stomach shadow

would point strongly toward acute ulcers, especially if associated with hyperacidity and occult blood in the stool.

A *Callous Ulcer* is usually recognized by its secondary effects, which are as follows:

1. Pyloric stenosis is commonly due to a contraction resulting from a callous ulcer. In fact, in most instances it is due to an old ulcer rather than to carcinoma, though the ulcer may at any time undergo malignant changes. Because of the obstruction at the pylorus, there is associated a progressive dilatation of the stomach. This is recognized by its size, and by the retention of food. This may be six hours, or may be ten days, as occurred in two patients of mine. This retention of bismuth food gives a characteristic basin-like shadow at the lower pole of the stomach, with often no other evidence of the stomach.

2. Reversed peristalsis occurs in connection with pyloric stenosis—more often with the organic stenosis, but may be seen in spasmodic stenosis of the pylorus. The waves of reversed peristalsis are of the same character as the direct.

3. Increased peristaltic waves in connection with pyloric stenosis, show not only greater depth, but are actually increased in the number that pass at any one time. It is common to see five or six, instead of the usual number, three. There are usually long intervals during which no waves pass.

4. Adhesions and fixation may occur in connection with a callous ulcer, though they are much more likely in perforating ulcer. When present, the stomach cannot be moved about as it can be under normal conditions. These same adhesions may distort or displace the stomach.

5. Organic contraction of the stomach may affect only a small area, usually on the lesser curvature, or may cause an hour-glass contraction. So too, the hour-glass contraction may be due in part to the organic contraction, and in part to spasmodic contraction.

6. Retraction of the pylorus toward the left is at times formed, and is likely due to the contraction of the lesser curvature caused by the disease.

7. Interference with the peristaltic waves will practically always be found when the ulcer is indurated. A wave may be seen on both curvatures, then be interrupted at the location of the ulcer usually on the lesser, while at the same time it may be seen to continue on the greater curvature.

Duodenal Ulcer.

The evidence of duodenal ulcer as shown by the Roentgen Rays, is in a developmental stage and while important, it is of less definite value than that obtained in gastric ulcer.

1. A Normal Stomach Shadow is found unless some other complication be present.

2. *Increased Peristalsis* has been observed. Barclay considers it evidence of duodenal ulcer whenever he finds a normal stomach shadow associated with excessive peristalsis, carrying the food out of the stomach more rapidly than normal. He has even observed that the stomach may empty itself within a half hour in these cases. Haudek on the other hand says that the time of emptying of the stomach is only slightly increased, so that at the end of six hours only slight remnants can be found.

Haudek also says that not infrequently a bismuth in water mixture passes through the pylorus immediately after taking, either spontaneously or by effleurage, which is in contrast to pyloric ulcer.

3. A *Normal Pylorus* is likely to be found in duodenal ulcer. By this I mean of normal width and thickness, as indicated by the clear space between the bismuth shadow in the stomach and that in the duodenum.

4. A *Painful Pressure* point may be found over the duodenum, and it should move upward with the drawing in of the abdomen. (Haudek.)

5. Resistance at the same location as the painful point, is evidence of a callous ulcer.

6. A *Remnant* of bismuth outside of the duodenal outline, associated with resistance, and not easily movable, points toward a penetrating duodenal ulcer.

7. *Constrictions* and secondary dilatations may result from the contraction of a callous duodenal ulcer, but similar effects may be produced by other forms of adhesions, and therefore this evidence must only be considered confirmatory.

8. *Occult* blood in the stool in association with the above evidence, would point toward an acute ulcer.

A very clever method of artificially distending the duodenum has been developed by Cole. It consists in allowing the patient to swallow an Einhorn duodenal tube. Near the metallic head of this tube is attached to a very thin rubber bag, which is distended at will with air forced through the tube. This blocks the duo-

denum and allows the part above it to be filled with bismuth food. Theoretically this would seem to meet a desired end, but practically there are a number of objections.

1st. It produces a sudden obstruction of the intestine, which at once will change the usual or normal action of the duodenum, and I would expect reversed peristalsis, spasmodic contraction, or blocking of collections of gas as well as food, all of which would be apt to lead to erroneous conclusions.

2nd. There is danger of traumatism more during the extraction of the tube than during its passage, especially when ulcer or carcinoma, or even dilated veins are present. However, it is a clever idea, and may be found useful in certain cases.

By a private communication, Cole says: "In regard to the Artificial Duodenal Dilatation I believe that this is of use in selected cases, particularly those in which one is anxious to determine the lumen of the second and third portions of the duodenum, rather than the cap. In such cases it is of real practical value. But I do not believe that it would be wise to attempt to use it as a routine procedure, because I believe that the irritation of the tube in the duodenum somewhat distorts, or causes a spasm of the pyloric sphincter.

Conclusions.

1. Gastric ulcer gives very positive evidence as shown by the Roentgen Rays.

2. In many instances the character and location of the ulcer can be determined.

3. The location and character of the ulcer will give a very definite idea as to the treatment; and when surgical, the character of the operation can be more definitely decided upon—whether a gastro-enterostomy, pylorictomy or local excision. If a gastro-enterostomy is decided upon the lowest point of the stomach can be determined by the rays and thus obtain the best drainage.

4. Some evidence of duodenal ulcer can be found.

5. The history, and other clinical evidence should not be neglected to arrive at an accurate diagnosis.

REFERENCES AND LITERATURE.

ASBURY: "X-Ray findings in Gastric and Duodenal Ulcer." The American Quarterly of Roentgenology. December, 1911.

BARCLAY: "Archive of the Roentgen Rays, 1910-XV-P-174."

BECKEY: Kontraktionsphänomene des Magens und ihre Benziehungen zur Pathologie."
Frankf. Zeitschr. f. Pathologie, Bd 7, H. 3. 1911.

BUDINGER: "Zur Pathologie und Therapie des Sanduhrmagens." Wiener klin. Wochenschrift 1901, No. 36.

COLE: Artificial Dilatation of the Duodenum for Radiographic Examination. Am. Quarterly of Roentgenology, Dec. 1911.

DEQUERVAINE: "Zur Roentgendiagnostik des runden Magengeschwürs." Münch. med. Wochenschr, No. 17th, 1911.

FAULHABER: "Zur Roentgendiagnostik des tiefgreifenden Ulcus ventriculi." Münch. med. Wochenschr, No. 40, 1910.

FAULHABER: "Die radiologische Untersuchung des Magens." Archiv. f. phys. Med. in med. Techink, III, u IV.

FAULHABER: "Zur Rontgendiagnostik des tiefgreifenden (kälosen) Ulcus ventriculi." Münch. med. Wochenschr, 4, Oct. 1910.

GROEDEL: "Die Röntgenologisch nachweisbare Merkmale der gastrektase und der Pyloroptose." Berliner klin Wochenschr, No. 15, 1908.

HAUDEK: "Die Rontgendiagnose des kallösen (penetrierender) Magen Geschwurs und ihre Bedeitung." Münch med. Wochenschr. No. 47, 1910.

HAUDEK: "Zur Röntgenologischen Diagnose der Ulceration in der Pars media des Magens." Münch. med. Wöchenschr, No. 30, 1910.

HAUDEK: "Radiologische Beiträge zur Diagnostik des Ulcus und Carcinoma ventriculi." Münch. med. Wochenschr, No. 8, 1911.

HAUDEK UND CLAIRMONT: "Die Bedeutung der Magenradiologie für die Chirrurgie Verlag von Gustav Fischer." Jena., 1911.

HAUDEK: "Die Diagnose des Ulcus duodeni in Roentgenbilde und seine Unterscheidung von Ulcus Pyloricus."

HOLZKNECHT UND JONAS: "Die Rontgenuntersuchung des Magens und ihre diagnostische Ergebnisse." Ergebnisse der inneren Med. und Kinderheilkunde. Bd. IV, 1910.

HOLZKNECHT: "Archives of the Roentgen Ray, November 1911."

JOLASSE: "Beitrag zur Rontgendiagnose des Sandenlermagens." Fostscher, a. d. Geb. d. Rontgenstrahlen, XI.

JONAS: "Zur Differentialdiagnose des ulcus ventriculi." Die radiologische Testellung der Zurgehorigkeit druck und schmerzhafter Punkte des abdomens zu den inneren Organen 25 Kongress, für innere Medizin, 1908.

JONAS: "Zur Pathologie und Diagnostik des spastichen Sandenlermagens." Winer klin. Rundschan, 47-48, 1909.

REICHE: "Die Rontgendiagnose des penetrierenden Magengeschwürs." Münch. med. Wochenschr, Jan. 3, 1911.

RIEDER: "Die chronische Magengenshwur und sein Roentgenologischer Nach-weis." Münch med. Wochenschr No. 48, 1910.

SCHMITT: "Zur Diagnose des Sandenlermagens." Archiv f. klin. Chir, 81, 1906.

SCHWARTZ: "Ein Fall von narbiger Pylorostenose mit Roentgenbefunde." Wiener klin. Wochenschr, 1910, No. 10.

STIERLIN: "Roentgenologische Erfahrungen über Magenopasmen."

TORNAY: "Beiträge zur Roentgen-diagnostik der Stenosen des Verdaunngstraktes." Berliner klin. Wochenschr No. 29, 1910.

Verhandlungen d. Deutsche Ges. f. Chirurgie,
1912, 40, P, 192

Fig. 1. Perforating gastric ulcer, with hour-glass contractions, and pyloric stenosis (due to adhesions). The arrow points to the abrupt termination of the perforation. Confirmed by operation by Prof. Rodman.

Fig. 2. Tetanic hour-glass contraction of the stomach due to small ulcer on the lesser curvature, studied and confirmed at operation by Prof. Laplace 4 years ago.

Fig. 3. Indurated gastric ulcer on the lesser curvature, which persisted during two hours of careful study. Spasmodic contraction on the opposite curvature. Double lines show peristaltic movement of the greater curvature, and partial obliteration of the indentation on the greater curvature. See sharp lines on border of indentation on the lesser curvature.

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Fig. 4. Spasmodic hour-glass contraction in the body of the stomach due to ulcer on the lesser curvature. Confirmed at operation by Dr. W. Hershey Thomas.

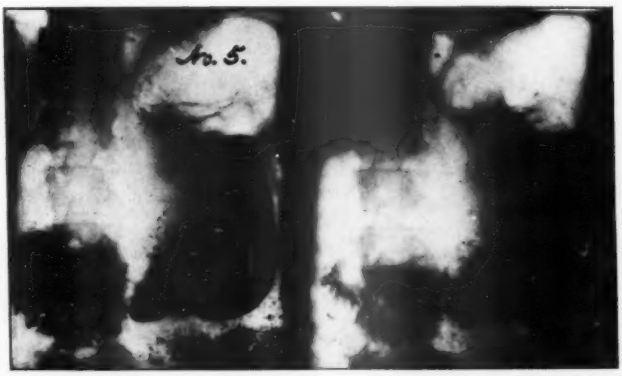

Fig. 5. Spasmodic hour-glass contraction in the lower third of the stomach, which persisted twenty minutes at a time, associated with a movable right kidney, in a physician who was subject to attacks of renal colic. Patient had no stomach symptoms.

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Fig. 6. Sharp indentation on the greater curvature, probably spasmodic. Evidence of duodenal adhesions. Patient had the symptoms and history of gastric ulcer.

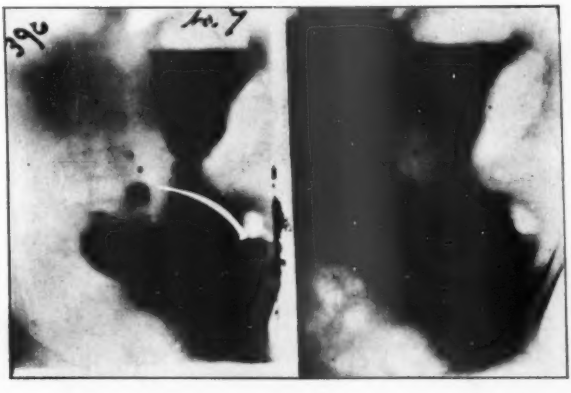

Fig. 7. Spasmodic hour-glass contraction due to ulcer on the lesser curvature. Confirmed at operation by Prof. Laplace. (White mark is an accident to the lantern slide.)

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Fig. 8. Shows the same stomach as in Fig. 7, but with no hour-glass contraction. Instead there are strong peristaltic waves attempting to overcome the pyloro-spasm.

Fig. 9. Hour-glass contraction of the stomach near the pylorus, due in part to adhesions, and in part to spasm, but caused by a gastric ulcer. Confirmed at operation by Dr. Gibbon.

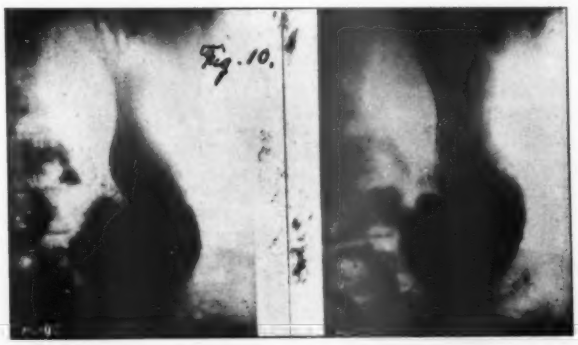

Fig. 10. Spasmodic contraction of the pyloric end of the stomach, due to ulcer. Typical symptoms of gastric ulcer, studied by Dr. Eberhard.

Note—These illustrations were copied from lantern slides because the original negatives had been sent out.

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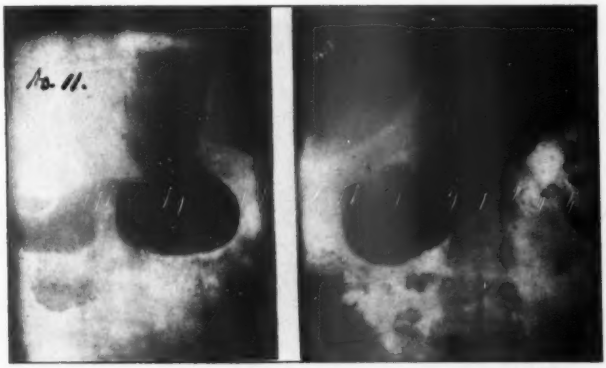

Fig. 11. Hour-glass contraction of the pyloric end, due to ulcer. The second picture shows the absence of this contraction. Studied clinically by Drs. Mallon and Allyn.

Fig. 12. Pyloric stenosis, due to old callous ulcer. Gastrectasis, confirmed at operation by Dr. Kennedy.

Fig. 13. Same case as in Fig. 12, showing the deep peristaltic waves found in pyloric stenosis.

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Fig. 14. Pyloric stenosis, due to old callous ulcer, showing gastrectasis and large number of peristaltic waves. Confirmed by Dr. Kennedy.

Fig. 15. Duodenal dilatation, due to adhesions, secondary to duodenal ulcer. Dr. Chew.

Fig. 16. Duodenal dilatation, due to adhesions, secondary to a pericholycystitis. See gallstones. Confirmed by Prof. Rodman.

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THE X-RAY STUDY OF 22 CASES OF PTOSIS OF THE STOMACH AND COLON BEFORE AND AFTER OPERATION.

BY MAX KAHN, M. D.

These cases have previously been reported by Dr. Bloodgood before the Gastro-Enterological Association in Atlantic City, June 3, 1912 (The American Jour. of Gastro-Enterology, July, 1912, ii, p. 11). At that time twenty cases operated upon were discussed. Since then two more operative cases have been observed. These cases were divided by Bloodgood into five groups:

Group 1. Four cases.—The anatomical findings at operation in these four cases were: A stomach in ptosis, greatly dilated with a distinct kink at the pylorus, and a ptosis of the right half of the colon; the cecum was usually in the pelvis, the hepatic flexure down, a redundant transverse colon, the right half resting parallel with the ascending colon. Clinically, in these cases there were the same gastric symptoms as in any cases of pyloric stenosis, and gastric residuum as shown by the stomach tube. In addition there was marked constipation with all the symptoms of colonic intoxication.

The X-rays before operation as shown in No. 4221 (Cullen) shows a stomach with the lesser curvature lower than the umbilicus, the greater curvature usually below the pubes, and, in addition to ptosis, great dilatation of the stomach. The bismuth was as a rule not expelled before four to six hours, sometimes longer. The position of the right half of the colon as found at operation was well shown in the X-ray. As a rule the bismuth was not expelled from the right half of the colon until after 48 hours. It, however, passed rapidly through the remaining portion of the left colon. There was no marked ptosis nor dilatation of the sigmoid. In one case only (Cullen) the splenic flexure pulled down. In three of these four cases the operation consisted of a resection of the stomach with anastomosis between the duodenum and the remaining portion of the stomach at the position of the greater curvature, and resection of the right half of the colon with anastomosis between the ileum and the

transverse colon. The inverted closed end of the transverse colon was fixed to the upper angle of the right rectus wound. This acted as an apron to hold the stomach up and straightened out the colon to the splenic flexure.

The X-rays after operation in these cases (see Cullen) show a stomach in correct position, usually emptying itself within three hours. In none of these cases did the bismuth remain in the duodenum. We find no shadow of the duodenum before, nor after operation. The X-rays also show the absence of the right half of the colon, the bismuth passes so quickly into the transverse colon that the anastomosis can be made out in only two cases. The plates show the transverse colon fixed in its new position and the remainder of the colon as before operation. Clinically, these patients have been relieved. In the fourth case, in which only the stomach was resected, the X-ray after operation (Cullen) shows the stomach in good position, but the right half of the colon still in ptosis. As this patient still suffered from his colonic stasis the right half of the colon was resected. The X-ray now shows (Cullen, to be made) the colon as in the other three cases. This patient is now relieved of all his gastric and colonic symptoms.

Group 2. Chronic Gastromesenteric Ileus with Ptosis of the Right Half of the Colon.—In the first report by Bloodgood there were but five cases, one other case has been observed since then. This one, from the X-ray standpoint is the most interesting, because in the X-ray three and four hours after bismuth by mouth the complete "U" of the dilated duodenum is shown.

In these six cases the anatomical findings at operation were: Extreme ptosis of the right half of the colon, an unusually dilated cecum in the pelvis, an ileum with a short mesentery. This allowed the huge cecum to pull on the mesentery of the small intestine and constrict the duodenum as it passed through the root of the mesentery between the mesenteric vessels.

In only one of these six cases was the stomach dilated to the extent observed in Group 1. In this case the stomach was resected as in Group 1. (Johnson 4084). We have no X-rays of this patient before operation.

In the remaining five cases the degree of ptosis and dilatation of the stomach was distinctly less than in Group 1. From an X-ray standpoint the most important finding is the dilatation of the duodenum which we fortunately got in our last case

(Rabinowitz). I am confident that if the X-ray pictures are taken every hour after the first two hours, the probabilities are that this dilatation of the duodenum will be shown. The colon in these cases differs very little from that in Group 1.

The X-ray after operation in the five cases in which the stomach was not resected shows that much of the ptosis of the stomach has been corrected, that the stomach empties itself more quickly (Harter, 3982) and so far we have been unable to see that any bismuth has been retained in the duodenum. The X-ray in the case in which the stomach was resected with a Kocher anastomosis, shows a result similar to those in Group 1. (Johnson 4084). The X-ray of the colon after operation in this group does not differ from that in Group 1. In some of the cases the anastomosis between the ileum and transverse colon is shown (Johnson, Harter).

Group 3. Ptosis of the Right Half of the Colon. Five cases, reported by Bloodgood and one observed since. (Bouffer). In these cases the stomach before operation is practically normal as pictured in the X-ray. A few show some ptosis and slight dilatation. In none of these cases was the bismuth retained in the duodenum. The X-rays show a marked ptosis of the right half of the colon with dilatation, kinks, and a cecum, usually in the pelvis. In these cases the bismuth remained in the cecum very long, in one case 190 hours (Wall 4107). (The X-rays were taken at St. Joseph's Hospital by Dr. Ashbury).

In these cases the right half of the colon only was resected, and the X-rays show the anastomosis and the corrected position of the transverse colon. (Sister Theresa 3859). In one of these cases there is a marked dilatation, elongation and ptosis of the sigmoid colon shown in the X-ray before operation, seen at operation, and again pictured in the X-ray after operation (Sister Theresa). This patient is the only one in this group who has not been relieved.

Group 4. Pericolitis—three cases. The X-ray before operation shows a practically normal stomach (Sodeski 4184). There is no ptosis of the right colon, but the ascending colon is parallel with the first portion of the transverse. The cecum in two cases was hugely dilated. In the X-ray shadow the stomach convolutions due to the contraction of the circular muscle is absent and there is a blurring of the entire X-ray shadow. The right half of the colon empties itself of the bis-

muth very slowly. The X-ray in two cases after operation (Sodeski 4184 and McDonald 4113) show the absence of the right colon, the anastomosis, the corrected position of the transverse colon, but in one case (McDonald) it shows a very elongated and dilated sigmoid colon, which was later resected with lateral anastomosis.

In this group only the right half of the colon was resected. In one case this was followed later by resection of the sigmoid as just noted.

Group 5. The anatomical findings in three cases here shows the redundant sigmoid with mesenteritis producing an obstruction between the descending colon and the first portion of the sigmoid. The X-ray before operation (Elliott 4068 taken by Dr. Ashbury at St. Joseph's Hospital) (Gurley and Forrest, taken by Dr. Baetjer at Johns Hopkins) shows that the bismuth stopped in the lower end of the descending colon, when given by mouth. When the bismuth is injected per rectum it fills the sigmoid, lifts it out of the pelvis, corrects the kink and the bismuth passes and fills the entire colon. In these three cases the descending colon and sigmoid were mobilized and a lateral anastomosis made between the descending colon and the lower sigmoid: the redundant colon was excised.

The X-ray after operation (Gurley) shows that the obstruction is completely relieved.

The X-ray, therefore, will portray pretty clearly the position of the stomach and colon. In group 2 it may show the dilatation of the duodenum. It shows not only the relative size and position, but if X-rays were taken at intervals after bismuth is given by mouth, they will give a good indication of the motoric function of the stomach and colon. As a rule in pericolitis the shadow is changed and the point of greatest dilatation of the colon will be brought out and sometimes kinks. To obtain an accurate picture of the sigmoid colon one must have X-rays after bismuth by mouth and after bismuth injected per rectum. For the right half of the colon the method of bismuth by mouth seems better.

After operation the X-ray studies demonstrate whether the anatomical conditions have been corrected. The more rapid evacuation of the stomach and colon is well shown.

One cannot make an accurate diagnosis from X-ray studies only, for frequently we see ptosis of both stomach and colon

without symptoms and without stasis. The surgeon, however, should, before operation, know exactly the symptoms complained of. Then, with the X-ray plates and his inspection on opening the abdomen he will be better prepared to relieve the symptoms. There, is however, much to be done in the X-ray investigation of cases before operation. In the stomach there should be more frequent pictures to ascertain the exact time of complete evacuation which is more important than the position of the stomach. If the duodenum retains the bismuth, it may be looked upon as good evidence of gastro-mesenteric ileus. The same is true to the colon. We want to know the time of complete emptying of the different parts of the colon. For this reason it seems advisable that in addition to making plates frequent fluoroscopic examinations be made if this can be done without danger to the patient and operator.

The technic employed was as follows: Each patient was prepared by purging the night before, or an enema given on the morning of examination, and a glass of milk given for breakfast. Immediately before examination the patient was given to drink an ounce of bismuth subcarbonate suspended in about 10 oz. of milk; then while in the erect position she was bent forward and backward and from side to side two or three times so that the bismuth would be equally distributed in the stomach. The patient was then placed in the prone position, the anode of the tube focused over the spine of the second lumbar vertebra at a distance of nineteen inches, and the patient instructed to hold her breath at the end of a deep inspiration at the count of three, when the radiograph was taken. In the cases where the rectal injection was given the patient was prepared in a similar manner. She was placed in the left lateral position and the hips elevated by means of two or three pillows at an angle of about 35 degrees. An ounce of bismuth subcarbonate was then suspended in 16 oz. milk and by means of a high rectal tube well lubricated inserted through the rectum for a distance of 18 to 20 inches, the bismuth suspension was gradually poured through a funnel. The patient was kept in this position for 30 minutes at the end of which time she was placed in the prone position, and a radiograph taken. The advantages of the rectal injection are that the outline of the colon and sigmoid can usually be obtained with one radiograph, thus economizing in the number of plates used, and the saving of time. In cases where bismuth

is given by mouth a picture of the colon can frequently be obtained at the end of twenty-four hours. In a considerable number of cases, however, it has either not reached the colon at this time, or has already passed out, so that it may be missed altogether. By means of the rectal injection this is advised. In those cases where it is desired to estimate the position of the stomach in relation to the colon the bismuth can be given by mouth first and a radiograph taken immediately, and then the rectal injection given for the colon, and another radiograph taken. Atony or hypermotility of the stomach can further be diagnosed by successive radiographs taken every 2 hours, and atony of the colon by radiographs taken every 24 hours.

EDITORIAL

The attention of the members of the society is especially called to the notice elsewhere of a proposed trip to attend the International Congress of Surgeons in London. The section on Radiology will undoubtedly be productive of good results and will be of great interest to those who can attend. The trip of the American members will serve to bring them closer together and to afford the opportunity not only of enjoying the work of the section but also of meeting many of their European confreres. This international exchange of ideas is certainly destined to raise the standard of American Roentgenology and to show our confreres across the water that we are striving to attain the highest type of excellence.

PROPOSALS FOR MEMBERSHIP.

The following physicians have made formal application to become members of the American Roentgen Ray Society and they have filled the requirements of the Constitution of said Society relative to applications for membership:

Dr. Myron Botsford Palmer, 55 S. Fitzhugh St., Rochester, N. Y. Recommended by Dr. C. Wentworth Hoyt, 365 East Ave., Rochester, N. Y.; Dr. H. M. Imboden, 480 Park Ave., New York City.

Dr. Samuel Stern, 41 West 51st St., New York City. Recommended by Dr. W. H. Stewart, 14 West 126th St., New York City; Dr. Leopold Jaches, 27 East 95th St., New York City.

EXTRACT FROM CONSTITUTION.

"Applications must be sent to the Chairman of the Executive Committee at least six months before the next meeting at which they are to be acted upon. He shall publish or cause to be published, the names and addresses of such applicants together with the names of the members proposing them, either in the 'QUARTERLY' or by a personal letter to each member of the Society, at least twice before the next meeting at which the names of applicants are to be acted upon. Any objections held by members against said applicants should be sent to the Chairman of the Executive Committee as soon as possible for filing."

A. F. HOLDING, M. D.,
Chairman of the Executive Committee.

ANNOUNCEMENT

The meeting of the Western members of the American Roentgen Ray Society will be held in Chicago on Feb. 22nd, 1913. The arrangements are in the hands of the local members, Dr. Hollis E. Potter and Dr. Case. An interesting program for the afternoon and evening meeting is certainly assured and those members of the society who will be able to attend will undoubtedly be amply repaid for the time.

These short informal meetings certainly tend to keep up the enthusiasm of the members and while not designed to at all replace the great event of the annual meeting will serve to stimulate the enthusiasm of the members and will be a distinct educational feature through the exchange of ideas and by the promotion of a free discussion.

THE INTERNATIONAL CONGRESS OF SURGERY, 1913, LONDON.

Many of our members will this year go to the International Congress of Surgery, to be held in London, England, beginning August 7th. A Radiology Section under the Presidency of Sir James McKenzie Davidson promises to be of special interest. By way of making the crossing of the ocean more enjoyable it was proposed at the last annual meeting that members should travel by the same boat. The Teutonic, sailing July 26th, has been selected as one likely to suit the majority. She is 10,000 tons, and sails from Montreal. She is a one class boat, and the fare is $55.00. Dr. Pirie of Montreal has arranged for a block of staterooms to be reserved for the party, and those who wish to travel by this boat should secure their places as soon as possible. Berths should be secured from the White Star Line direct. Members who intend to go are requested to communicate with Dr. Pirie, Royal Victoria Hospital, Montreal, who will make further arrangements for visits to the X-ray departments of London hospitals. A short trip in Germany could be arranged on board the Teutonic.

Some preliminary arrangements have been made for a meeting of the members of the A. R. R. Society with the Roentgen Society of London. Members are referred to the notices which will appear in the Lancet and British Medical Journal, of papers to be read at the meeting, and of the social functions which will take place. Fuller details will be given in the next quarterly journal. Meanwhile please secure your places on the Teutonic.

A. W. P.

CURRENT LITERATURE

Experiments on the Influence of Opium, Morphium, Pantopon and Morphine-Free Pantopon Upon the Digestive Tract.

DR. J. K. SCHWENTER, BERN.

Fortschritte auf dem Gebiete der Roentgenstrahlen, Vol. 19, page 1.

The author first cites the experiments of Magnus and Padtberg with regard to the influence of cathartics on the gastro-intestinal tract. Those of Magnus with infusum sennae show that this drug begins to have an effect only when it reaches the colon together with the meal, which must consist of meat, while castor oil excites the small intestine and retards the evacuation of the stomach; but rancid castor oil increases the emptying of the stomach:

Padtberg's observations on decoctum colocynthidis show that it influences mostly the small intestine, but its action on the stomach is very irregular.

It was found that all antiperistalsis of the proximal part of the large intestine was stopped by these drugs. Padtberg's experiments with magnesium sulphate dissolved in water showed that it acts as a laxative because it is not absorbed by the intestines. Also that the antiperistaltic motions of the proximal colon are not affected. The author further cites the experiments of Magnus with tincture of opium, in which that observer found that this drug causes a marked delay in the evacuation of the stomach, at times even an arrest of the meal in the oesophagus. He also found that a constriction was always present in the stomach between the fundus and the pylorus; but that the food passed normally through the pylorus from the antrum.

The small intestines were affected only slightly, and the antiperistaltic action of the proximal colon, as well as the peristaltic action of the distal colon, apparently remained unaffected.

Magnus (according to the author) also found that the effect of the tincture of opium was practically the same as that of morphine; except that with the former there was a larger residue in the oesophagus, longer delay in the stomach, more marked constriction at the antrum pylore, and greater delay at the pylorus, than with morphine.

Because the results of these experiments of Magnus were not in accord with the hitherto assumed effects of these drugs upon the intestines, which were supposed to be put at rest by them, the author undertook a series of experiments to ascertain the correctness of the observations made by Magnus.

The observations of Magnus and Padtberg were all made with the fluoroscope. The author, however, for the sake of obtaining permanent records, took instantaneous radiographs at certain intervals. He did not take any cinematographs, because that method is not yet sufficiently perfected. All plates were made in 1/100 second so that the restlessness of the cats experimented upon did not affect the clearness of the plates.

The experiments were made as follows: The cats were starved 24 hours before, and the drug was administered to them subcutaneously immediately before feeding, or per os with the food. The latter consisted of 20 grmms. of porridge thoroughly mixed with 4 grmms. of bismuth carbonate. As a control, 4 cats were fed with the bismuth porridge only. Each cat was kept in the same box throughout the time of the experiment (24 hours).

One side of this box was open and a net stretched on a frame was placed in the opening. For the exposure, the cassette was lowered through a slot at the other end of the box, and the cat then pressed against it with the aid of the net. Thereupon an instantaneous radiograph was immediately made.

The experiments on the normal cats showed that even immediately after the ingestion of the meal, no bismuth was left in the oesophagus, that the stomach emptied itself in three to five hours, that there was a very small quantity of fluid present, and that the "Magenblase" was at no time very large, and the peristalsis was very distinct. In the small intestine food could already be observed ¼ hour after ingestion, while in seven hours nothing was left. The colon was reached in ½ to ¾ hour. In 24 hours little was left in the proximal part, most of it was in the distal portion and the rectum. In the colon very distinct peristaltic incisures were noticed.

For the experiments with opium, the author used pure opium, morphine, pantopon, and morphine-free pantopon.* The results were as follows: larger or smaller quantities of the meal remained in the oesophagus for considerable periods of time; in the stomach 5, 7, 9, 13 and 14 hours. The "Magenblase" was large at the beginning, and increased as time went on. Peristalsis was not distinct, but a constriction was seen for a considerable period of time between the fundus and pylorus. In those animals in whom the drug was administered with the food, the small intestine was reached immediately. In those who received it subcutaneously, food entered the small intestines in from ¾ to 8 hours, while in both instances it was delayed for a long time in the small intestines, which were also widened and relaxed, especially in those animals who received morphine subcutaneously and opium by mouth. The colon was reached in 4-9 hours. It appeared relaxed, and peristaltic incisures were very shallow.

The author's conclusions are that the difference in effect of the individual forms of opiates was very slight; that greater variations were obtained according to the method of administration, those administered subcutaneously worked more rapidly than those by mouth. With the latter method the effect obtained on oesophagus and stomach came much slower, but on the small and large intestines the results were practically the same. The retardation of the food in the small intestines was not due to delay in the stomach, but to relaxation of the small intestines themselves. In the large intestine there also occurred relaxation and partial distension of the colon. Here the author disagrees with Magnus, who claims to have observed no effect of the opiates upon the antiperistaltic action of the proximal colon, or the peristalsis of the distal colon.

Schwenter believes that from the pharmacological point of view his observations are important, inasmuch as they confirm the opinion held that colon and small intestine are relaxed; in that it also shows that the action of morphine is distinct from that of the other alkaloids of opium; that drug administered by mouth are not as effective upon the stomach, because they probably leave it too soon.

The author also concludes that the instantaneous radiograph is superior to the fluoroscope in making such studies.

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*Pantopon consists of the chlorhydrates of the total alkaloids; 1 gramme of pantopon corresponds to 5 grammes of opium. It contains 0.5 grammes morphine and 0.4 grammes of the other alkaloids.

Gastro-Intestinal Diagnosis from Roentgenological Standpoint.

HENRY K. PANCOAST, M. D., PHILADELPHIA, PA.

Virginia Medical Semi-Monthly, Jan. 15, 1913.

After discussing the indications and technic for this work Pancoast cites the following cases as illustrating the more important gastro-intestinal conditions that belong within the realms of Roentgen ray diagnosis. 1. Large carcinoma, body of stomach. This was a Roentgen ray diagnosis entirely, as there were no direct clinical signs of carcinoma, which was hardly suspected as a possible condition. Confirmed by operation two days later, and partial gastrectomy performed. Note the small projection of the bismuth shadow into the clear area of the growth. This was found to be due to a crater in the latter.

2. The same case nearly four months after operation. Patient had pain and periodic retention. Roentgen ray diagnosis was made of possible recurrence in scar, and was confirmed at second operation. As metastasis had occurred, the case was inoperable further.

3. Extensive carcinoma stomach. Palpable mass. Operation was refused. Extension had evidently caused obstruction beyond in the duodenum.

4. Extensive carcinoma pyloric portion of stomach, not causing obstruction. Palpable mass. Considered inoperable.

5. Carcinoma pyloric portion of stomach without obstruction. Confirmed at operation, but inoperable further than exploration on account of extension.

6. Carcinoma pyloric portion stomach without obstruction. Palpable mass freely movable. Diagnosis based largely on Roentgen ray findings before gastric analysis was made.

7. Same case, five minutes later, patient lying on right side to demonstrate movability of growth.

8. Same case, two and one-half hours later, showing stomach nearly empty and collapsed, with no retention. Area of growth has dropped downward and to the left.

9. Same case, seven and one-half hours after first radiograph, to determine relations with transverse colon. Area of palpable mass outlined by wire corresponding with location at last examination, but lower and more to left than at first. Colon is below growth, and there is no obstruction in the bowel. Note that the bismuth has passed further than usual through the

large bowel, which conforms with the claim that hypermotility of the large bowel is commonly found in such cases. The Roentgen ray findings were all confirmed at operation, but metastasis prevented removal of the growth.

GASTRIC RETENTION.

10. Case of extreme gastroptosis, with dilatation and retention, illustrating examination by double bismuth meal method. This slide shows considerable retention six hours after the first meal, and due to mechanical obstruction and atony. Note head of bismuth column in cecum and tail in ileum.

11. Same case after second bismuth meal.

"HOUR-GLASS" CONSTRICTIONS.

12. Case of "hour-glass" constriction of stomach due to old ulcer scar and adhesions. Exact appearance duplicated at a subsequent examination, and diagnosis confirmed at operation.

13. Case in which this first radiograph suggested an "hour-glass" constriction. This was not confirmed by screen examination, which showed very slow peristalsis with deep contractions along the greater curvature, but with little, if any, along the lesser until near the pylorus.

14. Same case, proving radiographically that the appearance first suggesting "hour-glass" constriction was due to a peristaltic wave.

EFFECTS OF ADHESIONS—STOMACH AND DUODENUM.

15. Case of perigastric adhesions following operation for removal of gall stones. Condition suggested by position of stomach to right, drawing of greater curvature to right, and absence of free movability. Confirmed at operation.

16. Case of enormous distention of duodenum, cause not determined. Note vigorous gastric peristalsis.

17. Case of partial duodenal obstruction regarded as result of adhesions or possibly old ulcer. Note retention in stomach six hours after first meal, and head of column at hepatic flexure. Note also the appendix filled with bismuth.

18. Same case, after second bismuth meal, showing distention of duodenum. Diagnosis was suggested at this examination. Stomach of normal size, without ptosis.

19. Same case, eighteen hours after second meal, showing some dilatation of cecum, ptosis of right side of transverse colon,

and appearance suggesting adhesions between transverse and ascending colon and transverse colon and cecum. Appendix still contains bismuth, but tip has emptied somewhat.

20. Same case, patient lying on left side, just after last radiograph. Note that the supposedly adherent portion of the transverse colon remains in close apposition with ascending colon and cecum. This further suggests but does not prove adhesions, because the ascending colon has fallen down to the left with the transverse portion instead of holding it up.

21. Same case, at a later examination of the stomach to confirm the findings in connection with the duodenum. Roentgen ray findings confirmed at operation, gall bladder adhesions found constricting the duodenum. Note bismuth still in the appendix, remaining seventy-two hours, which is regarded as abnormal. Appendix was removed.

DUODENAL ULCER STENOSIS.

22. Case in which Roentgen ray findings suggested duodenal obstruction. This radiograph, made six and one-quarter hours after the first bismuth meal, shows gastric retention, with blockage in the duodenum. Findings confirmed at operation, showing old ulcer stenosis.

23. Same case, after second bismuth meal. Note appearance of duodenal cap.

THE LARGE BOWEL.

24. Case in which Roentgen ray examination suggested cecal adhesions, although symptoms pointed entirely to the left side as the seat of trouble, and where the bismuth column seemed to stop. Examination could not be completed on account of operation. This radiograph was made only four and one-half hours after the bismuth meal, showning no blockage on the right side. These findings confirmed at operation. Adhesions found on right side as suggested, and also around splenic flexure, and were released at each place.

25. Case in which cecal adhesions were suspected clinically, and suspicions confirmed by Roentgen ray examination. (Eighteen hours after meal.) No operation yet.

26. Case of suspected cecal adhesions, five years after appendectomy. Roentgen ray examination corroborates clinical diagnosis. Confirmed at operation. (Nineteen hours after meal.)

27. Case of obstruction just beyond ptosed hepatic flexure, probably due to adhesions, the clinical diagnosis aided by the Roentgen ray findings. This radiograph was made eighteen and one-half hours after the meal.

28. The same case, twenty-four hours later, or forty-two hours after the meal. Note the slow passage of bismuth through the point of probable constriction. Operation advised.

29. Case of suspected ptosis of the cecum. Examination shows ptosis of cecum and entire colon. The appearance suggested the possibility of cecal adhesions.

30. The same case, examined while lying on the left side. Note that the transverse colon falls away from the cecum, showing the absence of any adhesions binding them together. The cecum does not seem to be movable.

31. Case in which examination showed ptosis of the colon, and strongly suggested movable cecum. Erect posture, eighteen and one-half hours after meal. (Very little in cecum when examined six hours after the meal.)

32. Same case, examined while lying on the left side, and directly after the preceding exposure. Note the change in the position of the cecum.

33. Case of suspected post-operative adhesions on left side. This radiograph in erect posture suggests adhesions between transverse colon and sigmoid.

34. Same case, recumbent posture.

35. Case of ptosis of colon and redundant sigmoid. This radiograph shows the ptosed colon.

36. Same case, showing the redundant sigmoid.

37. Another case of redundant sigmoid. (Constipation relieved by proper use of purgatives.)

38. Case of boy, aged thirteen, with supposed obstruction in descending colon. At a previous operation a greatly thickened descending colon had been found, according to report. This examination, eighteen and one-half hours after the bismuth meal, shows stoppage of bismuth at the splenic flexure.

39. Same case, after administering bismuth enema, showing no evidence of obstruction in suspected portion of gut, but a marked dilatation of the cecum and transverse colon. The cecum could be observed clinically at times. The enema was readily taken. Radiograph twenty minutes later, in erect posture.

40. Same case, directly after last exposure, recumbent posture, plate posterior, to show sigmoid, which appears normal. Note the apparent twist at the splenic flexure, which was regarded as a very remote cause of obstruction, but was not found at the time of operation. The absence of haustra in the descending colon was regarded as somewhat significant especially in view of the history of previous operative findings. At operation no obstruction was found, the only abnormality being a thickened descending colon. This probably acted as an obstruction by its rigidity and interference with peristalsis, but the liquid bismuth enema could readily pass through by the slight force of gravity.

Rotch Method of Roentgenographic Age Determination.

H. W. SMITH, U. S. NAVY.

U. S. Naval Medical Bull., Jan. 1913.

Rotch appreciating the desirability of an improved means of grading children in relation to the requirements of schools and child-labor laws, studied the question and tentatively adopted the development of the bones of the wrist as an index of the general anatomic development. When it was first proposed to apply this method at the Naval Academy there were no relevant data obtainable. Smith suggested that a study of the process of amalgamation between the epiphyses and shafts of certain long bones might yield results comparable to those obtained by the Rotch method among children. The investigation was undertaken with two objects: To determine what value, if any, the method possessed; and, if it should be found deserving of adoption, to get sufficient data as to normals for its subsequent application to the examination of candidates presenting themselves for admission to the Naval Academy. It was hoped, also, that some anatomic information of value might be derived incidentally from the study concerning the union of the epiphyses.

1. An individual folder was to be prepared, which should contain the following information concerning each midshipman. The "Group" refers to a classification based on the strength test conducted by the medical officer in charge of physical training. 2. Roentgenograms were to be taken of the elbows and hands of all the men in the academy. 3. These were to be studied to learn what stages in the process of amalgamation could be clearly distinguished. 4. After the stages were determined, each epiphysis of each individual was to be inspected and labeled with a

number indicating the stage to which it belonged. 5. A chart was to be made of each stage of each epiphysis on co-ordinate paper—the ordinates to represent the number of men and the abscissae their respective ages, so that the height of the column over any age would indicate the number of men of that age in whom the given bone had reached the given stage. The serial numbers by means of which the columns were to be built up serve to mark the position of any individual. Thus we learn from "Radius stage 5" that there were in the Naval Academy three men of 20 years whose radii present that stage of development. We also learn from this chart how many men there are altogether who have reached that stage, the percentage they constitute of the total, the age distribution of the men entering into the curve and their identity. By this means it was hoped to obtain a curve which, by its highest point, should indicate the age at which the stage should occur, and by its relatively higher points the limits of normal variation. 6. It was almost certain that the form of these absolute curves would be largely determined by the chance general distribution of individuals of the various ages, and would in this way be less indicative of the age distribution of the men in any stage than if there were an equal number of men of each age among the total number examined. Since there are in all few men of 17 and many of 19, disproportionate weight would be given 19 in all the curves. In order to level the general age distribution it was first necessary to find the number of men of each age in the total number examined. This was to form a general age curve and later, a similar curve based on anatomic age was to be constructed. 7. Then a percentile curve was to be placed on each stage chart, this curve to represent in any column the percentage of all the men of that age who are found on that chart. For example, there were eight men in the Naval Academy who were 17 years of age. Of these, 1, or 12.5 per cent, occur in "stage 5" of the radius. Hence in the "17" column, "Radius stage 5" chart, we find an absolute number of 1 man, and a percentile number—13 per cent. 8. Averages were to be obtained which should corroborate the normals as indicated by the curves. 9. Having obtained from percentile curves the normal points, and the limits of normal variation, Smith hoped to be in a position to standardize each individual, noting his departure from normal, its direction and its extent. 10. Up to this point the immediate aim of the work was to get sufficient anatomic data on which to proceed; that is, to evolve the normal

standards without which anatomic age determination would be impossible.

Having accomplished this and having standardized each individual and noted any discrepancy between chronologic and anatomic age, it was then proposed to undertake a statistical study having as its object the demonstration of the influence of relative immaturity on the production of defectives. Smith has taken 1,654 plates of 914 men. After 1,447 plates had been examined, it became evident that no information would be derived from the study of the elbows of men of the age of these midshipmen, and, therefore, all his conclusions are drawn from the study of wrist plates. Otherwise the work progressed much as planned. Fourteen epiphyses selected for study were examined, and a careful description made of the appearances found. When descriptions had been written of each of the fourteen epiphyses in 723 individuals, it was found possible to divide the process of amalgamation into several stages. It was not attempted to make the stages conform to a certain predetermined number. On the contrary, it was found on the completion of the primary examinations that the stages that could be clearly distinguished were eight in number. The first sign of union seems to be the appearance of a minute, disk-shaped center of ossification in the clear space representing the cartilage, but close to the epiphysis. Others appear close by, and they become heaped up, forming what Smith terms imbrications. As they multiply they increase in size and some coalesce.

Other terms used in the description of the stages are self-explanatory. Stage 1. Complete separation, with no sign of beginning union. Stage 2. Complete separation, but a few imbrications appear in the clear cartilage. Stage 3. The imbrications have reached the proximal side, so that the clear line of cartilage is interrupted by them. In the radius this occurs to the outer side of center. Stage 4. The imbrications have accumulated, so that they occupy the cartilage space except at the periphery. They have enlarged and, to a large extent, become fused, the cartilage space being represented by interlacing multiple lines, formed by the spaces between the disks. There is still wide peripheral separation. Stage 5. The multiple lines have contracted to a thick line, which may show traces of irregularity. There are deep peripheral notches. Stage 6. The thick line has become narrow, but is distinct and extends the full width of the bone.

There usually remains a slight notch or depression at the periphery. Stage 7. Only portions of line or traces of notch remain. Stage 8. Amalgamation is complete. Union in the ulna and radius is first completed at or near the center. This is not quite true of the phalanges. With them the center is delayed and union is first completed in an intermediate zone, then in the center, and lastly at the periphery. The peripheral union may occur almost coincidently with the central, or even before. Usually there is thus left a space in the center which contracts to a double line and then to a thick line, which becomes shorter and may finally disappear, but which often persists in many individuals far into the twenties, long after similar lines have disappeared from the other bones. In spite of this slight variation in the process of union the general division of stages is applicable to the phalanges. Union does not occur coincidently in the various metacarpals and phalanges, the order in which they unite being—for the metacarpals—first and third, then the second and fourth, and lastly the fifth. For the phalanges, first and second, then the third and fourth, and finally the fifth. The thumb metacarpal is morphologically a phalanx. Each metacarpal and phalanx has but two centers of ossification, one for the shaft and for an end. The epiphysis is at the distal end of each of the four inner metacarpals and at the proximal end of the thumb metacarpal and of each of the primary phalanges. This fact enables Smith to include them all on one plate, together with the lower ends of the radius and ulna. The secondary and tertiary phalanges also have their respective periods of union, but they have not been recorded in this study. In fact, the metacarpals and phalanges have been recorded collectively and more attention has been given the ulna and radius.

The radius has been chosen for particular study, since its amalgamation requires a longer period of time for completion. The stages having been selected by the preliminary study, all the plates were again examined and the proper stage number given to each epiphysis according to its appearance. When this had been done, the construction of the curves was begun. An example of the method pursued may be given. John Smith, series number 657, age 18 years 6 months. The lower radius was seen to be in stage 6, and the lower ulna in stage 5. Then, on "Radius stage 6" chart, in column "18-6," the number "657" was placed. Similarly, on "Ulna stage 5" chart, in column "18-6," "657" was inserted. Thus each chart includes all the men of

whatever age in whom the development of the given bone could be said to grade the individual in that stage. Thirty-two such charts were found, one for each of the eight stages of each of the four bones—radium, ulna, metacarpals (collective), and phalanges (collective). Then percentile curves were made.

The study was stopped by Smith's inability to determine normals, without which standardization or comparison was impossible. It being practicable only very rarely, and then in extreme cases, to say that an individual is normal, precocious, or delayed, the statistical study that was to demonstrate the value of the method was not feasible. The method, therefore, does not furnish among subadults suitable normals by means of which standardization can be carried out. In this respect it fails, as do other similar methods, to supplant the chronologic system of grading, however defective that system may be.

What is the Roentgen Ray?

British Medical Journal, Jan. 11, 1913.

The nature of the Roentgen rays has long been a matter for speculation. The original theory of Stokes that they consisted of sets of ether ripples was generally accepted, in spite of the fact that no evidence could be produced of refraction, reflection, or diffraction. The failure of the strongest magnetic fields to produce deviation pointed to either disturbance and seemed to negative certain attempts to prove that the rays were corpuscular in character. More recently it was suggested by Professor Bragg of Liverpool that the rays may consist of neutral pairs of corpuscles. He was led to this conclusion as the result of some very ingenious experiments on the secondary radiations arising from surfaces irradiated by the Roentgen rays. This view was strongly combated by Professor Barkla of King's College, who produced further experiments as well as explanations of Bragg's results based on the more generally accepted ether-pulse view. The fact was, no crucial experiment had been devised. A few weeks ago Herr Laue announced a startling result. He found that when a narrow pencil of Roentgen ray passes through a crystal of zinc blende curious regular markings appear on a photographic plate placed behind the crystal. It looked at first as if this had to do with some diffraction effect; but Mr. W. L. Bragg (son of Professor Bragg), as the result of an experimental and theoretical investigation of the phenomenon, showed that the new results may be regarded as reflections from certain cleavage planes existing

in the crystal or, very probably, boundaries of molecular groups. This latter view is strengthened by the fact that the distribution of the rays of the beam are what might be expected from the recent theories of Barlow and Pope on crystal structure. In *Nature* of December 12th, 1912, Mr. Bragg described an experiment carried out on the suggestion of Mr. C. T. R. Wilson, F. R. S., in which the cleavage plane effect is clearly demonstrated. A narrow beam of Roentgen rays, obtained by a series of diaphragms, was allowed to fall at an angle of incidence of 80 degrees on a strip of mica 1 mm. thick mounted in thin aluminum. A photographic plate enclosed in two light-opaque envelopes was placed behind the mica in such a position that the direct rays would give a darkening, while, in addition, if any rays were reflected they also could affect the plate. Such an action was observed. It is almost certainly not merely a surface action, although an increase in the thickness of the mica did not produce an increase of the effect on the plate. Mr. Bragg demonstrated that there was true specular reflection obeying the usual optical laws. At a glancing angle the reflection was very marked. It would seem, therefore, that the Roentgen rays are composed of at least two sorts of rays, one capable of reflection and the other not. And, not for the first time, it would follow that both apparently antagonistic theories are right after all. It now remains to examine the respective ionizing and other properties of these rays, and to test their relative therapeutic values; and already, we believe, the workers in the radiotherapeutic department of the Cancer Hospital have taken up the question. The fact that the reflected rays can be concentrated ought to prove of great service.

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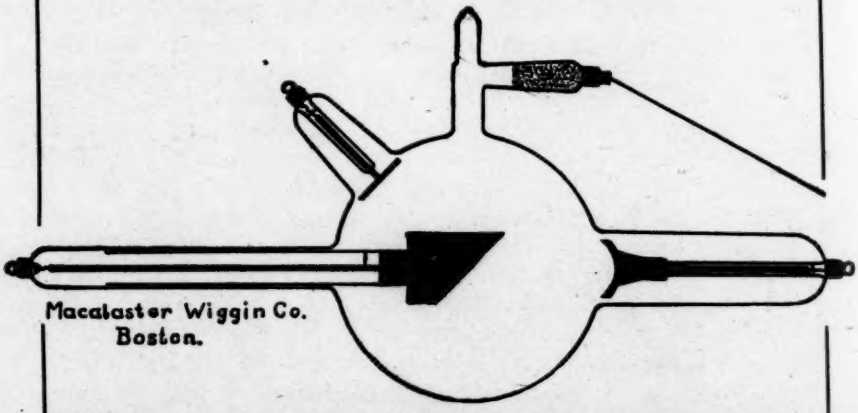

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